

## CLAIMS

1. An image pickup device having sensing elements arranged in a matrix, and an A/D converter provided for each column of said sensing elements, characterized in that said A/D converter first retains in its memory unit as an initial value an electric signal corresponding to a signal of said sensing element which is an analog signal, and said A/D converter then initiates charge or discharge of said memory unit at a rate corresponding to the size of input fixed signal, measures a time period from either the charge start time or the discharge start time until the electric signal of said memory unit becomes equal to the reference signal and recognizes the measured time period as a digital value.

2. The image pickup device according to claim 1, characterized in that said A/D converter comprises an integrator, and said initial value is determined by integrating for a certain period of time said sensing element's signal with said integrator, and the determined said initial value is either charged or discharged using said integrator.

3. The image pickup device according to claim 1, characterized in that said image pickup device comprises a digital counter, and said A/D converter comprises an integrator, a comparator and a digital

memory, wherein an output of said integrator is connected to an input of said comparator, an output of said comparator is connected to a loading trigger terminal of said digital memory, said digital counter 5 is connected to an input terminal of said digital memory and said digital counter output to be stored in said digital memory is the digital value.

4. The image pickup device according to claim 3, characterized in that said integrator comprises an 10 operational amplifier, a resistor to be connected to one of the input terminals of said operational amplifier, and a capacitor to be connected between the one of the input terminals and an output terminal of said operational amplifier.

15 5. The image pickup device according to claim 3, characterized in that said integrator comprises an operational amplifier, and a switched capacitor circuit which is connected to one of the input terminals of said operational amplifier.

20 6. The image pickup device according to claim 2, characterized in that said memory unit is an output portion of said integrator.

25 7. The image pickup device according to claim 1, characterized in that said sensing elements arranged in a column direction are selectively connected to a vertical output line, and said vertical output line and said A/D converter are connected via a voltage

amplifier.

8. The image pickup device according to claim 1, characterized in that said sensing elements arranged in a column direction are selectively connected to a 5 vertical output line, and said vertical output line and said A/D converter is connected via a noise reduction circuit, and said noise reduction circuit has a function to reduce the noise signal of said sensing element from the signal after sensing.

10 9. The image pickup device according to claim 1, characterized in that the reading of a row is commenced prior to the conclusion of the output of a signal of another row after sensing from the A/D converter.

15 10. An image pickup system comprising an image pickup device according to claim 1, an optical system which focuses light to said image pickup device, and a signal processing circuit which processes an output signal from said image pickup device.

20 11. An image pickup device having sensing elements arranged in a matrix, and an A/D converter provided for each column of said sensing elements, characterized in that said A/D converter retains in its memory unit as an initial value an electric 25 signal corresponding to the signal of said sensing element which is an analog signal, initiates charge or discharge of said memory unit by a subsequently

input first fixed signal, measures a time period from the start of said charge or said discharge until when said electric signal of said memory unit becomes equal to a reference signal, initiates charge or 5 discharge of said memory unit by a subsequently input second fixed signal, measures a time period for an electric signal exceeding said reference signal of said memory unit after measurement becomes equal to said reference signal, and recognizes the measured 10 time period as a digital signal.

12. The image pickup device according to claim 11, characterized in that said first fixed signal and said second fixed signal are the same.

13. The image pickup device according to claim 15 1, characterized in that the process of either re-charging or re-discharging in order to ensure that an electric signal exceeding said reference signal reaches said reference signal is repeated more than twice.

20 14. The image pickup device according to claim 1, characterized in that the process of either re-charging or re-discharging, in order to ensure that an electric signal exceeding said reference signal reaches said reference signal, is conducted through 25 the synchronous operation of two or more A/D converters provided for each column of sensing element.

15. The image pickup device according to claim  
11, characterized in that said sensing elements  
arranged in a column direction are selectively  
connected to a vertical output line, and said  
5 vertical output line and said A/D converter are  
connected via at least a voltage amplifier.

16. The image pickup device according to claim  
11, characterized in that said sensing elements  
arranged in a column direction is selectively  
10 connected to a vertical output line, and at least a  
noise reduction circuit is connected between said  
vertical output line and said A/D converter, and said  
noise reduction circuit has a function to reduce the  
noise signal of said sensing element from the signal  
15 after sensing.

17. The image pickup device according to claim  
11, characterized in that the differential voltage of  
the electric signal exceeding said reference signal  
and said reference signal is amplified by an  
20 amplifying means prior to being charged or discharged.

18. The image pickup device according to claim  
17, characterized in that the differential voltage of  
the electric signal exceeding said reference signal  
and said reference signal is retained in the first  
25 terminal, and said amplifying means voltage-amplifies  
said differential voltage retained in said first  
terminal via the amplifier after sample holding, and

overwrites the voltage subsequent to said voltage amplification onto said first terminal.

19. The image pickup device according to claim 11, characterized in that the reading of a row is 5 commenced prior to the conclusion of the output of a signal of another row of a digital data output operation after the A/D conversion.

20. An image pickup system comprising an image pickup device according to claim 11, an optical 10 system which focuses light to said image pickup device, and a signal processing circuit which processes an output signal from said image pickup device.